

Introduction

Genetic 'nets', or networks, GN - that form a living organism's genome -are mathematical models of functional genes linked through their non-linear, [dynamic](#) interactions.

A simple genetic (or gene) network GN_s may be thus represented by a [directed graph](#) G_D - the gene net digraph- whose nodes (or vertices) are the genes g_i of a cell or a multicellular organism and whose edges (arcs) are arrows representing the actions of a gene a_g^i on a linked gene or genes; such a directed [graph](#) representing a gene network has a canonically associated biogroupoid $\mathcal{G}_B$ which is generated or directly computed from the directed graph G_D .

Boolean vs. N-state models of genetic networks in LMn-logic algebras

The simplest, Boolean, or two-state models of genomes represented by such directed graphs of gene networks form a proper subcategory of the [category](#) of n-state genetic

networks, GN_{LM_n} that operate on the basis of a Łukasiewicz-Moisil n-valued logic algebra LM_n . Then, the category of genetic networks, GN_{LM_n} was shown in ref. [7] to form a subcategory of the [algebraic category of Łukasiewicz algebras](#), $\mathcal{LM}$ [7]. There are several published, extensive [computer simulations](#) of Boolean two-state models of both genetic and neuronal networks (for a recent summary of such [computations](#) see, for example, ref. [7]. Most, but not all, such mathematical models are Bayesian, and therefore involve computations for random networks that may have limited biological relevance as the topology of genomes, defined as their connectivity, is far from being random.

The [category of automata](#) (or [sequential machines](#) based on Chrysippean or Boolean logic) and

the category of (M, R) -systems (which can be realized as concrete metabolic-repair biosystems of enzymes, genes, and so on) are subcategories of the category of gene nets GN_{LM_n} . The latter corresponds to [organismic sets](#) of zero-th order S_0 in the simpler, Rashevsky's [theory of organismic sets](#).

Bibliography

References [\[14\] to \[34\]](#) in the ``[bibliography of category theory and algebraic topology](#)''

I. C. Baianu, J. F. Glazebrook, R. Brown and G. Georgescu.: Complex Nonlinear Biodynamics in Categories, Higher dimensional Algebra and Łukasiewicz-Moisil Topos: Transformation of Neural, Genetic and Neoplastic Networks, *Axiomathes*,16: 65-122(2006).

Baianu, I.C. and M. Marinescu: 1974, A Functorial Construction of (M,R)-Systems. *Revue Roumaine de Mathematiques Pures et Appliquees* 19: 388-391.

Baianu, I.C.: 1977, A Logical Model of Genetic Activities in Łukasiewicz Algebras: The Non-linear Theory. *Bulletin of Mathematical Biophysics*, 39: 249-258.

Baianu, I.C.: 1980, Natural Transformations of Organismic Structures. *Bulletin of Mathematical Biophysics* 42: 431-446

Baianu, I. C.: 1987a, Computer Models and Automata Theory in Biology and Medicine., in M. Witten (ed.), *Mathematical Models in Medicine*, vol. 7., Pergamon Press, New York, 1513-1577; [CERN Preprint No. EXT-2004-072](#)

Baianu, I.C., Brown, R., Georgescu, G., Glazebrook, J.F. (2006). Complex nonlinear biodynamics in categories, higher dimensional algebra and Łukasiewicz-Moisil topos: transformations of neuronal, genetic and neoplastic networks. *Axiomathes* 16(1-2):65-122.

Baianu, I.C., J. Glazebrook, G. Georgescu and R.Brown. (2009). A Novel Approach to Complex Systems Biology based on Categories, Higher Dimensional Algebra and Łukasiewicz Topos. *Manuscript in preparation*, 16 pp.

Georgescu, G. and C. Vraciu (1970). On the Characterization of Łukasiewicz Algebras., *J. Algebra*, 16 (4), 486-495.

"gene nets: physical and mathematical models" is owned by [bci1](#).

<http://planetphysics.us/encyclopedia/GeneNetsPhysicalAndMathemaicalModels.html>